

WHAT IS CLAIMED IS:

- 1                   1.     A micromechanical resonator device having at least one mode  
2     shape, the device comprising:  
3                   a substrate; and  
4                   a disk-shaped resonator disposed above the substrate and having at  
5     least one nodal point.
- 1                   2.     The device as claimed in claim 1 further comprising a support  
2     structure anchored to the substrate to support the resonator at the at least one nodal  
3     point above the substrate wherein both the resonator and the support structure are  
4     dimensioned and positioned relative to one another so that the resonator is  
5     substantially isolated during vibration thereof wherein energy losses to the substrate  
6     are substantially eliminated and wherein the resonator device is a high-Q resonator  
7     device.  
8
- 1                   3.     The device as claimed in claim 1 wherein the at least one  
2     mode shape includes a radial-contour mode shape.
- 1                   4.     The device as claimed in claim 1 wherein the at least one  
2     mode shape includes a flexural mode shape.
- 1                   5.     The device as claimed in claim 1 further comprising a drive  
2     electrode structure formed on the substrate at a position to allow electrostatic  
3     excitation of the resonator so that the resonator is driven in the at least one mode  
4     shape and wherein the resonator and the drive electrode structure define a capacitive  
5     gap therebetween.
- 1                   6.     The device as claimed in claim 5 wherein the drive electrode  
2     structure is disposed about a periphery of the resonator and wherein the at least one  
3     mode shape includes a radial-contour mode shape.

1                   7.     The device as claimed in claim 5 wherein the capacitive gap  
2     is a sub-micron, lateral, capacitive gap.

1                   8.     The device as claimed in claim 6 wherein the drive electrode  
2     structure includes a plurality of split electrodes.

1                   9.     The device as claimed in claim 1 wherein the at least one  
2     nodal point corresponds to a center of the resonator.

1                   10.    The device as claimed in claim 9 wherein the support structure  
2     is a single anchor positioned at the center of the resonator.

1                   11.    The device as claimed in claim 5 further comprising a sense  
2     electrode structure formed on the substrate at a position to sense output current  
3     based on motion of the resonator.

1                   12.    The device as claimed in claim 11 wherein the drive electrode  
2     structure includes a plurality of separate input drive electrodes and the sense  
3     electrode structure includes a plurality of separate output sense electrodes.

1                   13.    The device as claimed in claim 5 wherein the drive electrode  
2     structure is positioned beneath the resonator and wherein the at least one mode shape  
3     includes a flexural mode shape.

1                   14.    The device as claimed in claim 1 wherein the device is  
2     diamond-based.

1                   15.    The device as claimed in claim 1 wherein the device is silicon-  
2     based.

1                   16.    A micromechanical device comprising:  
2     a substrate;

3                   a disk-shaped input resonator disposed above the substrate and having  
4   at least one nodal point; and

5                   a disk-shaped output resonator disposed above the substrate and  
6   coupled to the input resonator and having at least one nodal point.

1                   17.    The device as claimed in claim 16 further comprising support  
2   structures anchored to the substrate to support the input and output resonators at  
3   their respective nodal points above the substrate.

1                   18.    The device as claimed in claim 16 further comprising an  
2   intermediate resonator disposed above the substrate and coupled to the input and  
3   output resonators and having at least one nodal point.

1                   19.    The device as claimed in claim 16 wherein the  
2   micromechanical device is a filter.

1                   20.    The device as claimed in claim 16 wherein the resonators are  
2   mechanically coupled together.

1                   21.    The device as claimed in claim 20 wherein the device is a  
2   bandpass filter.

1                   22.    The device as claimed in claim 16 wherein the resonators are  
2   electrically coupled together.

1                   23.    The device as claimed in claim 22 wherein the device is an  
2   integrable filter.

1                   24.    The device as claimed in claim 20 further comprising a  
2   coupling spring for mechanically coupling the resonators together.

1                   25.    The device as claimed in claim 16 further comprising a drive  
2   electrode structure formed on the substrate at a position to allow electrostatic

3 excitation of the input resonator and a sense electrode structure formed on the  
4 substrate at a position to sense output current based on motion of the output  
5 resonator.

1                   26.     The device as claimed in claim 18 further comprising a drive  
2 electrode structure formed on the substrate at a position to allow electrostatic  
3 excitation of the input resonator, a sense electrode structure formed on the substrate  
4 at a position to sense output current based on motion of the output resonator and an  
5 intermediate electrode structure formed on the substrate at a position for enhanced  
6 access to a response of the device.

1                   27.     The device as claimed in claim 18 further comprising a non-  
2 adjacent coupler for mechanically coupling the input resonator to the output  
3 resonator wherein the device is a bridged filter.

1                   28.     The device as claimed in claim 16 wherein the device is a  
2 mixer.

1                   29.     The device as claimed in claim 1 wherein the resonator has  
2 at least one anti-nodal portion where the resonator experiences the most  
3 displacement when driven and wherein the device further comprises sensing means  
4 for sensing motion of the anti-nodal portion.

1                   30.     The device as claimed in claim 29 wherein the sensing means  
2 includes at least one projection projecting from the anti-nodal portion to move  
3 therewith and means coupled to the at least one projection to provide an output  
4 representation of motion of the anti-nodal portion.

1                   31.     The device as claimed in claim 30 wherein the means includes  
2 at least one electrode structure.

1                   32.     The device as claimed in claim 1 further comprising a single  
2 electrode structure formed on the substrate at a position to allow electrostatic

- 3 excitation of the resonator and to sense output current based on motion of the
- 4 resonator.